Hall Ticket No | | | | | | | | | | | Question Paper Code: AHSB04

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech I Semester End Examinations (Regular) - November, 2018

Regulation: IARE – R18

WAVES AND OPTICS

Time: 3 Hours **(Common to AE | ME | ECE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Describe Davisson-Germer experiment to demonstrate the wave character of electrons. **[7M]**
   (b) What will be the KE of an electron if its de Broglie wavelength equals the wavelength of the yellow line of sodium 5896^0A. The rest mass of electron is $m_0 = 9.1\text{x}10^{-31}$kg and h = $6.63\text{x}10^{-34}$ J-s. **[7M]**

2. (a) Show that the energy of a particle enclosed in a rigid one dimensional infinite potential box is quantized. **[7M]**
   (b) Find the lowest energy that an electron (mass =9.1 x 10^{-31} Kg) can have if confined to move along the edge of an impenetrable box of length 4 x 10^{-10}m. **[7M]**

UNIT – II

3. (a) Discuss Kronig Penney model and hence show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands **[7M]**
   (b) Draw Energy band diagram for conductor, semiconductor and insulator. **[7M]**

4. (a) What is Hall effect? Show that the Hall coefficient is $R_H = \frac{V_H t}{IB}$ **[7M]**
   (b) A silicon plate of thickness 1 mm, breadth 10mm and length 100mm is placed in a magnetic field of 0.5 Wb/m^2 acting perpendicular to its breadth. If 10^{-2} A current flows along its length. Calculate hall voltage developed. R_H = 3.66 x $10^{-4}m^3$/C. **[7M]**

UNIT – III

5. (a) With a neat diagram discuss construction, working and uses of He-Ne Laser. **[7M]**
   (b) Calculate the wavelength of emission from GaAs semiconductor laser whose band gap energy is 1.44 ev (Plank's constant is 6.625 x 10^{-34}Js and charge of an electron is 1.6 x 10^{-19} C.) **[7M]**

6. (a) Define numerical aperture. Derive an expression for acceptance angle of an optical fiber. **[7M]**

   (b) Discuss the classification of optical fiber based on the refractive index **[7M]**

UNIT – IV

7. (a) Derive an expression for fringe width from Young's double slit experiment. Show that fringe width of bright and dark fringe is equal. **[7M]**

   (b) In Young's double slit experiment a 2cm space on the screen placed at 200cm contains 20 fringes. Find the fringe width and slit separation if the wave length of light used is 5100^0A. **[7M]**

8. (a) Describe Fraunhofer diffraction due to a single slit and deduce the position of the maxima and minima. **[7M]**

   (b) Explain the construction and working of Michelson interferometer. **[7M]**

UNIT – V

9. (a) What is simple harmonic motion? Derive a relation for displacement, time period, velocity and acceleration of a particle executing simple harmonic motion. **[7M]**

   (b) Define damped harmonic oscillation? Derive wave equation for damped oscillation. **[7M]**

10. (a) What are transverse and longitudinal wave? Give one example of each. Discuss the terms associated with a wave **[7M]**

    i. Frequency
    ii. Time period
    iii. Wave length

    (b) The equation of certain traveling waves is y(x,t) = 0.0450 sin(25.12x - 37.68t - 0.523) where x and y are in meters, and t in seconds. **[7M]**

    Determine

    i. Amplitud
    ii. Wave number
    iii. Wavelength
    iv. Angular frequency
    v. Frequency
    vi. Phase angle

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